

INSTRUCTION MANUAL

PS

112-118

080302

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PRECISION INSTRUMENTS FOR SCIENCE AND INDUSTRY

POWER SUPPLY

MODEL

112 - 118

S.N. 1102

SPECIFICATIONS

MODEL 112

OUTPUT RANGE:	Constant voltage: 0 to 50 volts Constant current: 0 to 3 amps
OUTPUT IMPEDANCE:	DC to 100 Hz: Less than 0.02 ohms 100 Hz to 1KHz: Less than 0.4 ohms 1KHz to 1MHz: Less than 2 ohms
RIPPLE AND NOISE:	Constant voltage: Less than 200 microvolts rms Constant current: Less than 100 microamps rms
LINE REGULATION:	Constant voltage: Less than 0.005% $\pm$ mv for 105 to 130 volts rms change Constant current: Less than 0.005% $\pm$ 400 microamps for 105 to 130 volts rms change
LOAD REGULATION:	Constant voltage: Less than 0.01% $\pm$ 5 millivolts Constant current: Less than 0.05% $\pm$ 500 microamps
OVERLOAD PROTECTION:	Automatic crossover, voltage-to-current or current-to-voltage
TRANSIENT RECOVERY TIME:	Constant voltage: Less than 100 microseconds Constant current: Less than 10 milliseconds
REMOTE PROGRAMMING:	Constant voltage: 0.5k ohms/volt or 0.1 volts/volt Constant current: 667 ohms/amp or 0.367 volts/amp
TEMPERATURE COEFFICIENT:	Constant voltage: 0.05%/°C $\pm$ millivolt Constant current: 0.1%/°C $\pm$ 5.0 milliamps
INPUT:	105 volts rms, 230 watts, to 130 volts rms, 300 watts 50 to 60 Hz

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SECTION 1

SPECIFICATIONS

SPECIFICATIONS MOD 104

OUTPUT RANGE:

Constant voltage: 0 to 10 volts
Constant current: 0 to 10 amps

OVERLOAD PROTECTION:

Automatic crossover, voltage-to-current or current-to-voltage

OUTPUT IMPEDANCE:

DC to 100 Hz: Less than 0.005 ohms
100 Hz to 1 KHz: Less than 0.1 ohms
1 KHz to 1 MHz: Less than 2 ohms

TRANSIENT RECOVERY TIME:

Constant voltage: Less than 50 microseconds
Constant current: Less than 10 milliseconds

RIPPLE AND NOISE:

Constant voltage: Less than 100 microvolts rms
Constant current: Less than 250 microamps rms

REMOTE PROGRAMMING:

Constant voltage: 2.5k ohms/volt or 0.4 volts/volt
Constant current: 200 ohms/amp or 0.1 volts/amp

LINE REGULATION:

Constant voltage: Less than $0.005\% \pm 1$ mv for 105 to 130 volts rms change
Constant current: Less than $0.005\% \pm 500$ microamps for 105 to 130 volts rms change

TEMPERATURE COEFFICIENT:

Constant voltage: $0.05\%/^{\circ}\text{C} \pm 200$ microvolts
Constant current: $0.1\%/^{\circ}\text{C} \pm 12.5$ milliamps

LOAD REGULATION:

Constant voltage: Less than $0.01\% \pm 1$ millivolts
Constant current: Less than $0.05\% \pm 1.25$ milliamps

OPERATING TEMPERATURE:

Range 0 to $+50^{\circ}\text{C}$

INPUT:

105 volts rms, 160 watts, to 130 volts rms, 200 watts, 50 to 60 Hz

Fig. 4-6

SPECIFICATIONS MOD 105

OUTPUT RANGE:

Constant voltage: 0 to 20 volts
Constant current: 0 to 5 amp

OUTPUT IMPEDANCE:

DC to 100 Hz: Less than 0.01 ohms
100 Hz to 1 KHz: Less than 0.2 ohms
1 KHz to 1MHz: Less than 2 ohms

RIPPLE AND NOISE:

Constant voltage: Less than 150 microvolts rms
Constant current: Less than 125 microamps rms

LINE REGULATION:

Constant voltage: Less than $0.005\% \pm 1$ mv for 105 to 130 volts rms change
Constant current: Less than $0.005\% \pm 625$ microamps for 105 to 130 volts rms change

LOAD REGULATION:

Constant voltage: Less than $0.01\% \pm 2$ millivolts
Constant current: Less than $0.05\% \pm 625$ microamps

OVERLOAD PROTECTION:

Automatic crossover, voltage-to-current or current-to-voltage

TRANSIENT RECOVERY TIME:

Constant voltage: Less than 75 microseconds
Constant current: Less than 10 milliseconds

REMOTE PROGRAMMING

Constant voltage: 1.25k ohms/volt or 0.25 volts/volt
Constant current: 400 ohms/amp or 0.2 volt/amp

TEMPERATURE COEFFICIENT:

Constant voltage: $0.05\%/^{\circ}\text{C} \pm 400$ microvolts
Constant current: $0.1\%/^{\circ}\text{C} \pm 6.25$ milliamps

OPERATING TEMPERATURE:

Range 0 to $+50^{\circ}\text{C}$

INPUT:

105 volts rms, 160 watts, to 130 volts rms, 200 watts, 50 to 60 Hz

SPECIFICATIONS MOD 106

OUTPUT RANGE:

Constant voltage: 0 to 50 volts
Constant current: 0 to 2 amps

OUTPUT IMPEDANCE:

DC to 100 Hz: Less than 0.02 ohms
100 Hz to 1 KHz: Less than 0.4 ohms
1 KHz to 1MHz: Less than 2 ohms

RIPPLE AND NOISE:

Constant voltage: Less than 200 microvolts rms
Constant current: Less than 50 microamps rms

LINE REGULATION:

Constant voltage: Less than $0.005\% \pm 1$ mv for 105 to 130 volts rms change
Constant current: Less than $0.005\% \pm 100$ microamps for 105 to 130 volts rms change

LOAD REGULATION:

Constant voltage: Less than $0.01\% \pm 5$ millivolts
Constant current: Less than $0.05\% \pm 250$ microamps

OVERLOAD PROTECTION:

Automatic crossover, voltage-to-current or current-to-voltage

TRANSIENT RECOVERY TIME:

Constant voltage: Less than 100 microseconds
Constant current: Less than 10 milliseconds

REMOTE PROGRAMMING:

Constant voltage: 0.5k ohms/volt or 0.1 volts/volt
Constant current: 1k ohms/amp or 0.5 volts/amp

TEMPERATURE COEFFICIENT:

Constant voltage: $0.05\%/^{\circ}\text{C} \pm 1$ millivolt
Constant current: $0.1\%/^{\circ}\text{C} \pm 2.5$ milliamps

OPERATING TEMPERATURE:

Range 0 to 50°C

INPUT:

105 volts rms, 160 watts, to 130 volts rms, 200 watts 50 to 60 Hz

SECTION 2

GENERAL INFORMATION

2.1 INSPECTION

When the unit is received, the customer should inspect it for any shipping damage. Remove the top cover of the unit to inspect the printed circuit boards. The printed circuit boards should be removed, inspected and replaced in their proper slots, one at a time. The component side of each board should be facing the front of the module. Do not alter the controls on the printed circuit boards; if any control is moved, the unit will be out of calibration.

2.2 SHIPPING KIT

The shipping kit should be inspected when the unit is received and should include the following:

- One power cord
- One set of unassembled patch pins
- One shorting bar

2.3 MOUNTING

MOD power sources are designed to be used as single power units or incorporated with other MODS into optional racks.

NOTE: Before installing the modules into racks, remove the handles. Also remove the patch plate from the rack which blocks air flow into the unit.

2.4 CONNECTORS

A 3-pin connector is used for the AC power input. Connections are provided on the front panel and the rear patchboard connector for ground and the plus (+) and minus (-) outputs. The rear patchboard also provides all additional connections for remote programming and sensing.

2.5 PATCH PIN ASSEMBLY

The shipping kit contains a set of unassembled patch pins. Figure 2-1 shows the proper way to assemble the patch pins.

2.6 INITIAL OPERATION

Prior to the application of power, insure that the unit is protected by a fuse located at the rear of the module.

The unit is programmed for normal operation by the patch cords at the rear patchboard connector at the factory. These patch cords should not be removed until another mode of operation is desired.

Plug the AC line cord into a 115 volt 60 Hz source and turn the POWER switch to the ON position. Set the METER switch to VOLT and observe the front panel meter. Insure that the voltage can be controlled in a range from zero volts to the maximum rated output voltage of the unit.

Set the METER switch to CUR and short the power supply output. Insure that the current can be controlled in a range from zero amperes to the maximum output current of the unit.

2.7 COOLING

For proper operation, the air surrounding the unit should be maintained between 0°C and +50°C, with a relative humidity not to exceed 70%. When racks are used, it is recommended that flushing fans be used (MOD fan module).

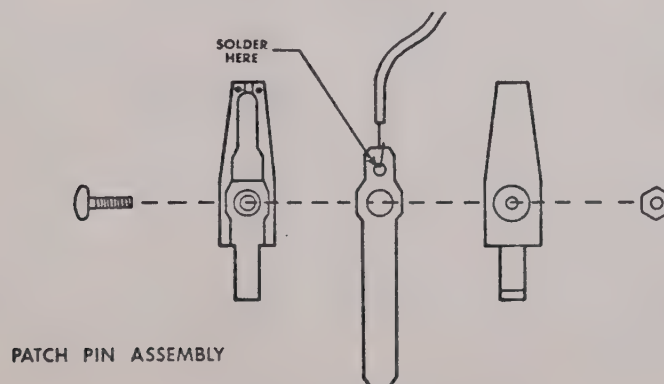


FIGURE 2-1

SECTION 4

OPERATING INSTRUCTIONS

4.1 NORMAL FRONT PANEL OPERATION

For "normal operation" (front panel operation): Jumper between 15 and 16, 17 and 18, 40 and 50, 42 and 52, 44 and 54, 48 and 49; as shown in Figure 4-1.

The MOD Power Supplies, as shipped from the factory, are wired for "normal" power supply operation. The metal strap on the front panel binding posts should be connected between the chassis ground and the low side of the power supply to reduce the output noise. In the "normal" power supply operating mode, the sense leads are connected to the front panel binding posts. The unit, when in operation, will function as a constant voltage power supply at the voltage set by the front panel voltage control knobs. As the output or load current is increased, the unit will automatically crossover to a constant current mode of operation. The point of crossover from constant voltage to constant current is set by the current control knobs on the front panel. To obtain the best regulation in the constant current mode of operation, the meter switch should be in the "current" position. (Note: The meter can draw up to 100 microamps from the power supply output current if the meter switch is in the VOLTAGE position. This will reduce the degree of current regulation by 100 microamps.)

To set the constant current point, set the meter switch to "current," short the output terminals of the supply together and adjust the current control knobs for the required current as indicated by the meter.

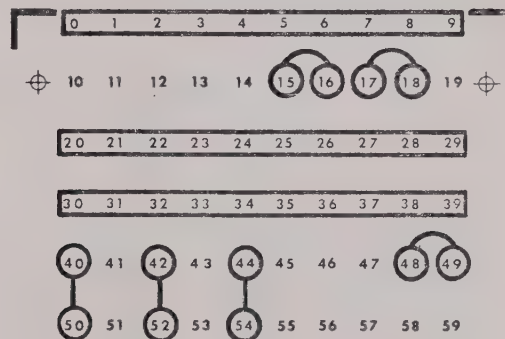


FIGURE 4-1

4.2 EXTERNAL VOLTAGE SENSE

For external voltage sense: Jumper between 17 and 18, 40 and 50, 42 and 52, 44 and 54; 16 is (+) sense lead, 49 is (-); see Figure 4-2.

The sense leads must be connected to the correct polarity at the load. The sense leads will draw less than 2 milliamps, but a finite voltage drop will occur in the sense leads due to the sense current. Adequate precautions should be taken with regard to the sense lead length and wire size based on 2 milliamps of sense current and the degree of voltage regulation required at the load. The voltage drop between the output of the power supply and the load should not exceed 1 volt.

In order to minimize noise pickup in the sense leads, they should either be twisted together or shielded. The low side of the power supply should be connected to chassis ground either at the front panel or the rear panel. If rear panel connection is desired, connect a jumper between Pin 20 (20 through 29) and the low output side of the power supply, Pin 00 (00 through 09) for (+) voltage, or Pin 30 (30 through 39) for (-) voltage.

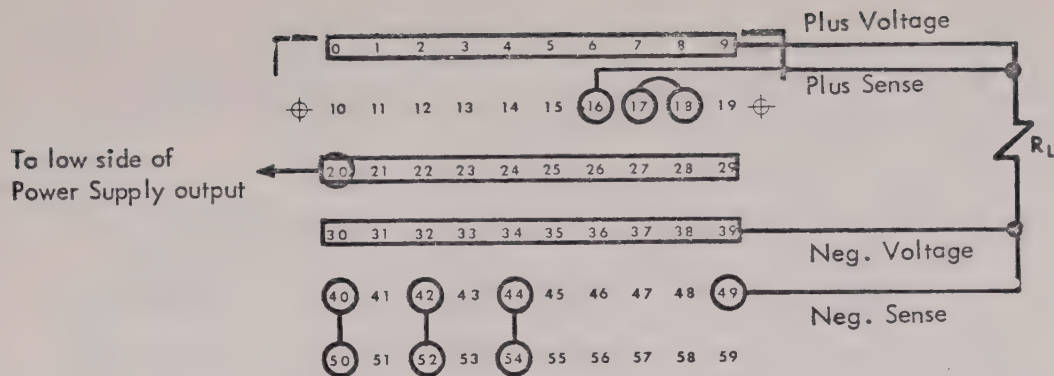


FIGURE 4-2

4.3 VOLTAGE PROPORTIONAL TO RESISTANCE

Voltage proportional to an external resistance value: Jumper between 15 and 16, 17 and 18, 40 and 50, 42 and 52, 44 and 54; connect external resistor between 47 and 48; see Figure 4-3.

The external resistance is connected between Pin 47 and the negative supply voltage; i.e., Pin 48 for front panel operation. The connection from the external resistance to the negative supply voltage is the (-) sense lead. The output voltage will change according to the value of external resistance used as shown below:

MOD 104

2.5k ohms/volt

MOD 105

1.25k ohms/volt

MOD 106

0.5k ohms/volt

The accuracy of the output voltage versus resistance is $\pm 10\%$. Greater accuracy ($\pm 1\%$) can be obtained by recalibrating the power supply internally. This is accomplished by connecting the desired resistance to the power supply and adjusting Pot R-23 on the first plug-in printed circuit board for the absolute voltage required. If a switch is used to select external resistance values, a make-before-break switch should be used. If the resistor is momentarily removed from the circuit, the output of the supply will increase, momentarily, to its maximum output voltage. In order to minimize noise pickup in the leads to the external resistor, the leads should be twisted or shielded. The low side of the power supply output should be connected to ground.

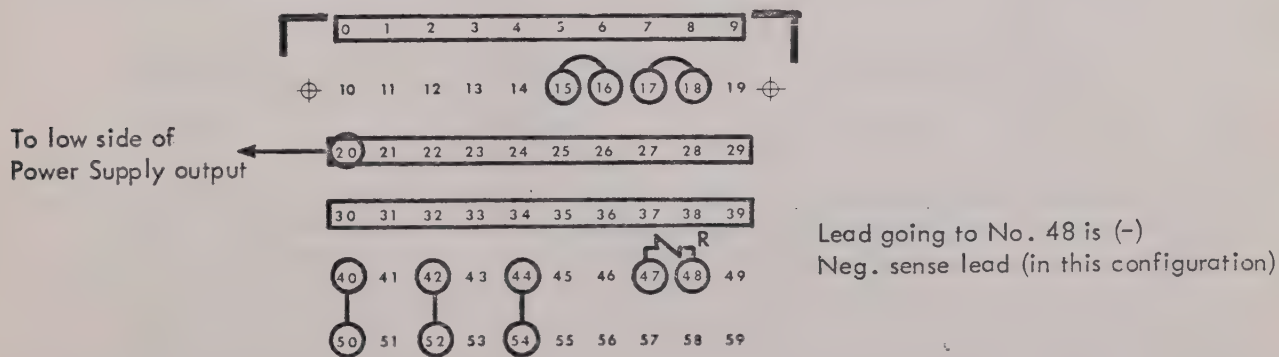


FIGURE 4-3

4.4 VOLTAGE PROPORTIONAL TO VOLTAGE REFERENCE

Voltage proportional to an external control voltage: Jumper between 18 and 54, 40 and 50, 42 and 52, 48 and 49; connect 15 and 19 to (+) side of reference voltage; connect 17 to (-) side of reference voltage; see Figure 4-4.

The output voltage will change according to the value of external control voltage as shown below:

<u>MOD 104</u>	<u>MOD 105</u>	<u>MOD 106</u>
0.4 volts/volt	0.25 volts/volt	0.1 volts/volt

To calibrate the unit, apply the required control voltage for full supply output voltage and adjust the front panel voltage control knobs for the specified output voltage from the supply. The input resistance, as seen by the external control voltage source, is greater than 1 megohm. The source resistance of the external control voltage source should be less than 1k ohms to obtain the specified power supply stability. Precautions should be taken to avoid pickup in the external leads. The low side of the power supply output should be connected to ground.

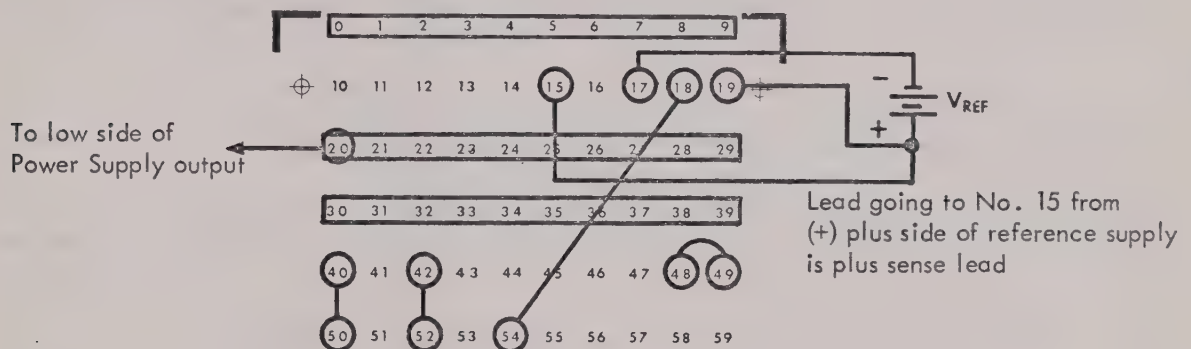


FIGURE 4-4

4.5 CURRENT PROPORTIONAL TO RESISTANCE

Current proportional to an external resistance value: Jumper between 15 and 16, 17 and 18, 44 and 54, 48 and 49; connect 40 and 52 to one side of resistor and 19 to other side; see Figure 4-5.

<u>MOD 104</u>	<u>MOD 105</u>	<u>MOD 106</u>
0.2k/amp	0.4k/amp	1k/amp

The accuracy of the output current versus resistance is $\pm 10\%$. Greater accuracy can be obtained by recalibrating the power supply internally. This is accomplished by connecting the desired resistance to the power supply and adjusting Pot R-22 on the first plug-in printed circuit board for the absolute current required. The output current versus resistance is slightly non-linear, but will vary less than $\pm 10\%$ from the best straight line drawn through the response curve. If a switch is used to select external resistance values, a make-before-break switch should be used. If the resistor is removed from the circuit, or too large a value is selected, the power supply will not be short-circuit current limited and may be destroyed.

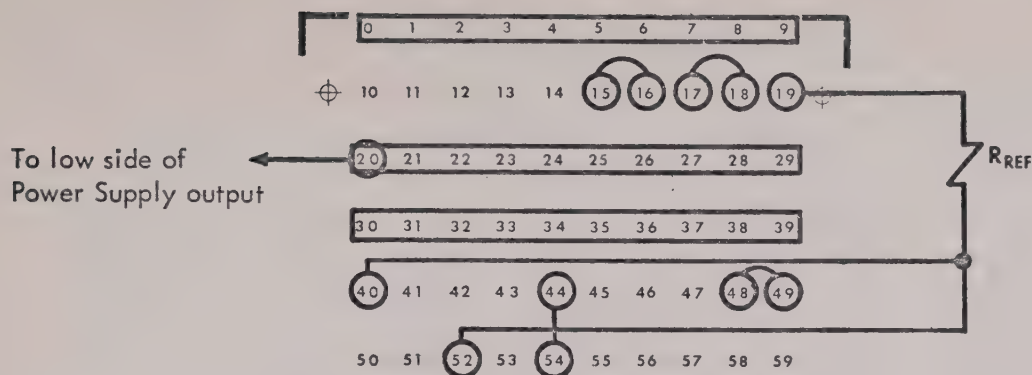


FIGURE 4-5

4.6 CURRENT PROPORTIONAL TO VOLTAGE REFERENCE

Current proportional to an external control voltage: Jumper between 15 and 16, 17 and 18, 40 and 50, 44 and 54, 48 and 49. Connect 52 to (+) side of reference voltage; connect 19 to (-) side of reference voltage; Figure 4-6.

The accuracy of the output current versus external control voltage is $\pm 2\%$ of the rated supply current. The input resistance, as seen by the external control voltage source, is greater than 1 megohm. The source resistance of the external control voltage source should be less than 1k ohms to obtain the specified power supply stability. If the external control voltage exceeds the specified value, the power supply will not be short-circuit current limited and may be destroyed.

Precautions should be taken to avoid pickup in the external leads. The low side of the power supply output should be connected to ground.

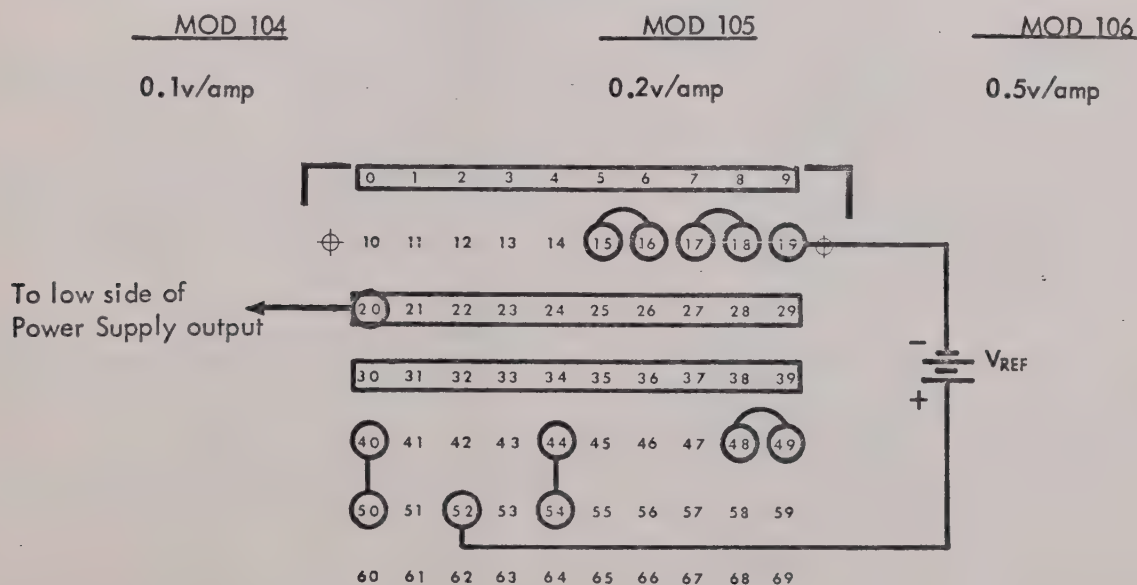
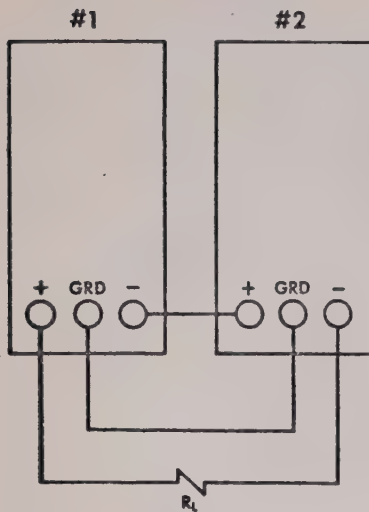
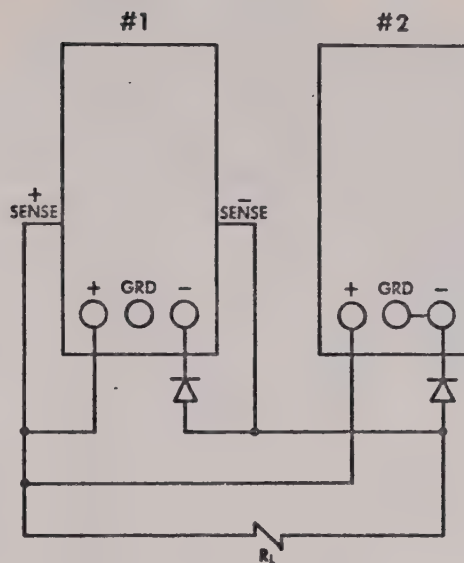


FIGURE 4-6

SERIES OPERATION



PARALLEL OPERATION



REAR PATCH CONNECTIONS

#1	#2
16(+ Sense)	15 to 16
17 to 18	17 to 18
40 to 50	40 to 50
42 to 52	42 to 52
44 to 54	44 to 54
49(-Sense)	48 to 49

Diodes are 1N1191R or equivalent

SERIES AND PARALLEL OPERATION OF MOD POWER SUPPLIES

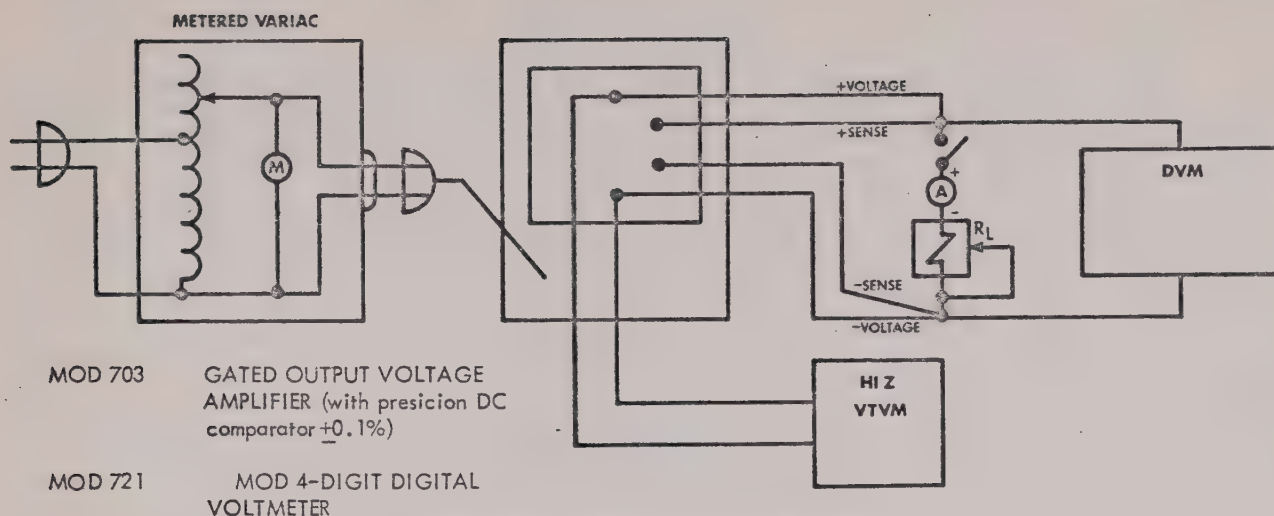
SECTION 5

REGULATION AND RIPPLE CHECK

1. Connect the power supply AC input to metered variac or variable auto-transformer.
2. Connect load resistor to the output terminals of the power supply through a switch and DC ammeter. The load resistor should be such that the rated load current is obtained with rated output voltage.
3. Connect a differential voltmeter or digital voltmeter DIRECTLY to the power supply output terminals. The differential voltmeter must not be connected to the load or to the wires going to the load.
4. Connect an AC vacuum tube voltmeter with shielded leads to the output terminals of the power supply.
5. LOAD REGULATION:
 - a. Adjust the variac for 115 volts as indicated by the variac.
 - b. Close load switch and adjust load resistor for rated output current as indicated by the DC ammeter, with the power supply output set at rated voltage.
 - c. The load regulation can be measured by alternately opening and closing the switch and observing the voltage change on the differential voltmeter.
6. LINE REGULATION:

With rated output current SW1 closed, vary the line voltage as indicated by the variac from 105 to 130 volts AC. The line regulation can be observed on the differential voltmeter.
7. RIPPLE:

With the AC input voltage set at 115 volts, rated output current and voltage, the ripple may be observed on the AC vacuum voltmeter or other low bandwidth HI input impedance voltmeter.



TEST SETUP FOR REGULATION AND RIPPLE

SECTION 6 CALIBRATION

Equipment required:

DC Voltmeter Weston 931 series or equivalent

DC Ammeter Weston 931 series or equivalent

MOD Board Extender Part No. 43300

1. With power supply turned OFF, zero the voltage and current meter movements.
2. Turn power ON; set current control to mid-range and voltage controls to full clockwise.
3. Connect a voltmeter to the plus and minus output terminals.
4. Adjust trimpot, R14, on the Regulator Board for the maximum rated output voltage of the unit.
5. Adjust trimpot, R29, on the Regulator Board so that the voltage meter on the front panel is the same as the 1% voltmeter reading.
6. Reduce the voltage output of the unit to about 5 volts and set the current controls to full clockwise.
7. Connect a current meter to the output terminals of the unit.
8. Adjust trimpot, R41, on the Regulator Board for the maximum rated output current of the unit.
9. Adjust trimpot, R28, so that the current meter on the front panel is the same as the 1% current meter.

SECTION 7

TROUBLE SHOOTING

Prior to trouble shooting the supply, it should be returned to the normal mode of operation as described in Section 4, paragraph 4.1 of this manual. Insure that the patch pins are properly placed as shown in Figure 4-1, and that there are no extra patch pins in the Patch Board Connector.

If the unit operates as it should when it is programmed as described in Section 4, paragraph 4.1, return the unit to the desired mode of operation carefully following the Figure which describes the desired mode of operation.

If the supply continues to malfunction check for broken patch pin wires and broken wires within the unit.

7-1 LOAD AND LINE REGULATION OUT OF SPECIFICATION: PROBABLE CAUSE:

- a. Differential voltmeter improperly hooked up. (see Section 5)
- b. A. C. input voltage below minimum operating value. Check A. C. input voltage at power supply input terminals.
- c. Supply in current limiting mode. Check load current.

7-2 HIGH OUTPUT VOLTAGE:

- a. Shorted series regulator transistor.
- b. Shorted driver transistor.

7-3 INPUT FUSE BLOWS:

- a. Rectifiers may be shorted.
- b. Filter or output capacitors may be shorted
- c. Possible shorted turn in transformer

REV	DESCRIPTION	DATE	APPROVED
A	PRELIMINARY	10/11/51	AL
B	REVISED	10/11/51	AL
C	REVISED	10/11/51	AL
D	REVISED	10/11/51	AL
E	REVISED	10/11/51	AL
F	REVISED	10/11/51	AL

TABULATION																															
SH	MOD. NO.	TITLE	681-227	68	G#	A71-A97	A#	A5	A6	A7	A10	A11	A12	A13	A14	A15	A24	C1	C20	T11	C#										
1	109	109-15A	23W715	23W715	23W711	2	23W702	1	23W711	103K170	220	2200	22W	48	5W	10K	21.5	14.1K	21.7	12W	5522K	500V	470	1.50U							
2	110	109-15A	23W715	23W715	23W711	2	23W702	1	23W711	103K170	220	2200	22W	48	5W	10K	21.5	14.1K	21.7	12W	5522K	500V	470	1.50U							
3	111	109-15A	23W715	23W715	23W711	2	23W702	1	23W711	103K170	220	2200	22W	48	5W	10K	21.5	14.1K	21.7	12W	5522K	500V	470	1.50U							
4	112	109-15A	23W715	23W715	23W711	2	23W702	1	23W711	103K170	220	2200	22W	48	5W	10K	21.5	14.1K	21.7	12W	5522K	500V	470	1.50U							
5	113	109-15A	23W715	23W715	23W711	2	23W702	1	23W711	103K170	220	2200	22W	48	5W	10K	21.5	14.1K	21.7	12W	5522K	500V	470	1.50U							
6	114	109-15A	23W715	23W715	23W711	2	23W702	1	23W711	103K170	220	2200	22W	48	5W	10K	21.5	14.1K	21.7	12W	5522K	500V	470	1.50U							
7	115	109-15A	23W715	23W715	23W711	2	23W702	1	23W711	103K170	220	2200	22W	48	5W	10K	21.5	14.1K	21.7	12W	5522K	500V	470	1.50U							
8	116	109-15A	23W715	23W715	23W711	2	23W702	1	23W711	103K170	220	2200	22W	48	5W	10K	21.5	14.1K	21.7	12W	5522K	500V	470	1.50U							
9	117	109-15A	23W715	23W715	23W711	2	23W702	1	23W711	103K170	220	2200	22W	48	5W	10K	21.5	14.1K	21.7	12W	5522K	500V	470	1.50U							
10	118	109-15A	23W715	23W715	23W711	2	23W702	1	23W711	103K170	220	2200	22W	48	5W	10K	21.5	14.1K	21.7	12W	5522K	500V	470	1.50U							
11	119	109-15A	23W715	23W715	23W711	2	23W702	1	23W711	103K170	220	2200	22W	48	5W	10K	21.5	14.1K	21.7	12W	5522K	500V	470	1.50U							
12	120	109-15A	23W715	23W715	23W711	2	23W702	1	23W711	103K170	220	2200	22W	48	5W	10K	21.5	14.1K	21.7	12W	5522K	500V	470	1.50U							
13	121	109-15A	23W715	23W715	23W711	2	23W702	1	23W711	103K170	220	2200	22W	48	5W	10K	21.5	14.1K	21.7	12W	5522K	500V	470	1.50U							
14	122	109-15A	23W715	23W715	23W711	2	23W702	1	23W711	103K170	220	2200	22W	48	5W	10K	21.5	14.1K	21.7	12W	5522K	500V	470	1.50U							
15	123	109-15A	23W715	23W715	23W711	2	23W702	1	23W711	103K170	220	2200	22W	48	5W	10K	21.5	14.1K	21.7	12W	5522K	500V	470	1.50U							
16	124	109-15A	23W715	23W715	23W711	2	23W702	1	23W711	103K170	220	2200	22W	48	5W	10K	21.5	14.1K	21.7	12W	5522K	500V	470	1.50U							
17	125	109-15A	23W715	23W715	23W711	2	23W702	1	23W711	103K170	220	2200	22W	48	5W	10K	21.5	14.1K	21.7	12W	5522K	500V	470	1.50U							
18	126	109-15A	23W715	23W715	23W711	2	23W702	1	23W711	103K170	220	2200	22W	48	5W	10K	21.5	14.1K	21.7	12W	5522K	500V	470	1.50U							
19	127	109-15A	23W715	23W715	23W711	2	23W702	1	23W711	103K170	220	2200	22W	48	5W	10K	21.5	14.1K	21.7	12W	5522K	500V	470	1.50U							
20	128	109-15A	23W715	23W715	23W711	2	23W702	1	23W711	103K170	220	2200	22W	48	5W	10K	21.5	14.1K	21.7	12W	5522K	500V	470	1.50U							
21	129	109-15A	23W715	23W715	23W711	2	23W702	1	23W711	103K170	220	2200	22W	48	5W	10K	21.5	14.1K	21.7	12W	5522K	500V	470	1.50U							
22	130	109-15A	23W715	23W715	23W711	2	23W702	1	23W711	103K170	220	2200	22W	48	5W	10K	21.5	14.1K	21.7	12W	5522K	500V	470	1.50U							
23	131	109-15A	23W715	23W715	23W711	2	23W702	1	23W711	103K170	220	2200	22W	48	5W	10K	21.5	14.1K	21.7	12W	5522K	500V	470	1.50U							
24	132	109-15A	23W715	23W715	23W711	2	23W702	1	23W711	103K170	220	2200	22W	48	5W	10K	21.5	14.1K	21.7	12W	5522K	500V	470	1.50U							
25	133	109-15A	23W715	23W715	23W711	2	23W702	1	23W711	103K170	220	2200	22W	48	5W	10K	21.5	14.1K	21.7	12W	5522K	500V	470	1.50U							
26	134	109-15A	23W715	23W715	23W711	2	23W702	1	23W711	103K170	220	2200	22W	48	5W	10K	21.5	14.1K	21.7	12W	5522K	500V	470	1.50U							
27	135	109-15A	23W715	23W715	23W711	2	23W702	1	23W711	103K170	220	2200	22W	48	5W	10K	21.5	14.1K	21.7	12W	5522K	500V	470	1.50U							
28	136	109-15A	23W715	23W715	23W711	2	23W702	1	23W711	103K170	220	2200	22W	48	5W	10K	21.5	14.1K	21.7	12W	5522K	500V	470	1.50U							
29	137	109-15A	23W715	23W715	23W711	2	23W702	1	23W711	103K170	220	2200	22W	48	5W	10K	21.5	14.1K	21.7	12W	5522K	500V	470	1.50U							
30	138	109-15A	23W715	23W715	23W711	2	23W702	1	23W711	103K170	220	2200	22W	48	5W	10K	21.5	14.1K	21.7	12W	5522K	500V	470	1.50U							
31	139	109-15A	23W715	23W715	23W711	2	23W702	1	23W711	103K170	220	2200	22W	48	5W	10K	21.5	14.1K	21.7	12W	5522K	500V	470	1.50U							
32	140	109-15A	23W715	23W715	23W711	2	23W702	1	23W711	103K170	220	2200	22W	48	5W	10K	21.5	14.1K	21.7	12W	5522K	500V	470	1.50U							
33	141	109-15A	23W715	23W715	23W711	2	23W702	1	23W711	103K170	220	2200	22W	48	5W	10K	21.5	14.1K	21.7	12W	5522K	500V	470	1.50U							
34	142	109-15A	23W715	23W715	23W711	2	23W702	1	23W711	103K170	220	2200	22W	48	5W	10K	21.5	14.1K	21.7	12W	5522K	500V	470	1.50U							
35	143	109-15A	23W715	23W715	23W711	2	23W702	1	23W711	103K170	220	2200	22W	48	5W	10K	21.5	14.1K	21.7	12W	5522K	500V	470	1.50U							
36	144	109-15A	23W715	23W715	23W711	2	23W702	1	23W711	103K170	220	2200	22W	48	5W	10K	21.5	14.1K	21.7	12W	5522K	500V	470	1.50U							
37	145	109-15A	23W715	23W715	23W711	2	23W702	1	23W711	103K170	220	2200	22W	48	5W	10K	21.5	14.1K	21.7	12W	5522K	500V	470	1.50U							
38	146	109-15A	23W715	23W715	23W711	2	23W702	1	23W711	103K170	220	2200	22W	48	5W	10K	21.5	14.1K	21.7	12W	5522K	500V	470	1.50U							
39	147	109-15A	23W715	23W715	23W711	2	23W702	1	23W711	103K170	220	2200	22W	48	5W	10K	21.5	14.1K	21.7	12W	5522K	500V	470	1.50U							
40	148	109-15A	23W715	23W715	23W711	2	23W702	1	23W711	103K170	220	2200	22W	48	5W	10K	21.5	14.1K	21.7	12W	5522K	500V	470	1.50U							
41	149	109-15A	23W715	23W715	23W711	2	23W702	1	23W711	103K170	220	2200	22W	48	5W	10K	21.5	14.1K	21.7	12W	5522K	500V	470	1.50U							
42	150	109-15A	23W715	23W715	23W711	2	23W702	1	23W711	103K170	220	2200	22W	48	5W	10K	21.5	14.1K	21.7	12W	5522K	500V	470	1.50U							
43	151	109-15A	23W715	23W715	23W711	2	23W702	1	23W711	103K170	220	2200	22W	48	5W	10K	21.5	14.1K	21.7	12W	5522K	500V	470	1.50U							
44	152	109-15A	23W715	23W715	23W711	2	23W702	1	23W711	103K170	220	2200	22W	48	5W	10K	21.5	14.1K	21.7	12W	5522K	500V	470	1.50U							
45	153	109-15A	23W715	23W715	23W711	2	23W702	1	23W711	103K170	220	2200	22W	48	5W	10K	21.5	14.1K	21.7	12W	5522K	500V	470	1.50U							
46	154	109-15A	23W715	23W715	23W711	2	23W702	1	23W711	103K170	220	2200	22W	48	5W	10K	21.5	14.1K	21.7	12W	5522K	500V	470	1.50U							
47	155	109-15A	23W715	23W715	23W711	2	23W702	1	23W711	103K170	220	2200	22W	48	5W	10K	21.5	14.1K	21.7	12W	5522K	500V	470	1.50U							
48	156	109-15A	23W715	23W715	23W711	2	23W702	1	23W711	103K170	220	2200	22W	48	5W	10K	21.5	14.1K	21.7	12W	5522K	500V	470	1.50U							
49	157	109-15A	23W715	23W715	23W711	2	23W702	1	23W711	103K170	220	2200	22W	48	5W	10K	21.5	14.1K	21.7	12W	5522K	500V	470	1.50U							
50	158	109-15A	23W715	23W715	23W711	2	23W702	1	23W711	103K170	220	2200	22W	48	5W	10K	21.5	14.1K	21.7	12W	5522K	500V	470	1.50U							
51	159	109-15A	23W715	23W715	23W711	2	23W702	1	23W711	103K170	220	2200	22W	48	5W	10K	21.5	14.1K	21.7	12W	5522K	500V	470	1.50U							
52	160	109-15A	23W715	23W715	23W711	2	23W702	1	23W711	103K170	220	2200	22W	48	5W	10K	21.5	14.1K	21.7	12W	5522K	500V	470	1.50U							
53	161	109-15A	23W715	23W715	23W711	2	23W702	1	23W711	103K170	22																				

SECTION 9

RECOMMENDED SPARE PARTS LIST

<u>Box No.</u>	<u>Description</u>	<u>Value or Part No.</u>	<u>Qty</u>
848	Transistor	2N4248	3
828	Transistor	2N1711	1
846	Transistor	2N3904	3
824	Transistor	2N1132	1
843	Transistor	2N3715	5
847E	Transistor (specify supply)	MJ 413	1
249A	Diode	MR1121	1
237	Diode	1N759A	1
234	Diode	1N753A	1
244F	Diode	1N4003	1
239	Diode	1N914	3
154	Capacitors	500uf, 50v	1
145B	Capacitors	50uf, 50v	2
142	Capacitors	10uf, 25v	2
135	Capacitors	5uf, 50v	1
116	Capacitors	2uf, 50v	1
359	Potentiometer	10k	2
349	Potentiometer	5k	2
247	Rectifier Bridge	MDA-962-3	1
245A	Rectifier Bridge	MDA-942A-2	1
	Filter Capacitors (specify supply)		1
	Meter	30575	1
488	Resistor, 1/4w 1%	1 meg	1
471C	Resistor, 1/4w 1%	40.2k	1
451	Resistor, 1/4w 1%	6810	1
478K	Resistor, 1/4w 1%	182k	1
459	Resistor, 1/4w 1%	12.4k (Assy 42074)	1
450	Resistor, 1/4w 1%	6340 (Assy 42075)	1
429	Resistor, 1/4w 1%	2610 (Assy 42076)	1
446	Resistor, 1/4w 1%	5490	1
436B	Resistor, 1/4w 1%	3320	1
420	Resistor, 1/4w 1%	1740	1
409	Resistor, 1/4w 1%	1k	1
607H	Resistor, 2w 10%	68 (Assy 42074)	2
607E	Resistor, 2w 10%	220 (Assy 42075)	2
610M	Resistor, 2w 10%	800 (Assy 42076)	2

ASSEMBLIES

Regulator Board (assembled)	Assy 42074, 42075, 42076	1
Resistor Board (assembled)	Assy 41114 (specify supply)	1
Pass Transistor Assembly (assembled)	Assy 42086 (specify supply)	1
Fan Assembly (assembled)	Assy 42051 (specify supply)	1
Transformer	(specify supply)	1

1 November 1968

Prices subject to change without notice

Minimum order charge of \$25.00

Please order by Box Number

SECTION VI

WARRANTY

The PRECISION STANDARDS CORPORATION warrants each instrument to be free from defects in material and workmanship. The instrument must be returned to the factory with shipping prepaid and a complete report of the difficulty. This warranty is good for one year from the shipping date.

SHIPPING DAMAGE

If there is any damage to the instrument upon receipt, report this to the transportation claim agent immediately.

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